

AD-A093 746

ARMY MOBILITY EQUIPMENT RESEARCH AND DEVELOPMENT COMM--ETC F/6 13/6  
VERIFICATION TESTS OF THE US ELECTRICAL CORP. ELECTRIC LEOPARD.(U)  
OCT 80 E J DOWDIALLO, I R SNELLINGS EC-77-A-31-1042  
MERADCOM-2312

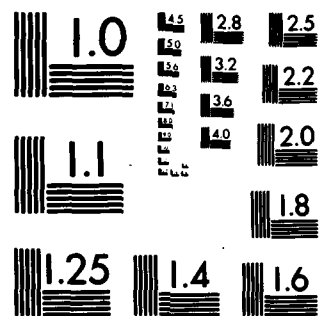
UNCLASSIFIED

NL

1 x 1  
4/4 x 4/4



END  
DATE  
FILMED  
2-81  
DTIC



MICROCOPY RESOLUTION TEST CHART

NATIONAL BUREAU OF STANDARDS-1963-A

154  
AD A093746

**LEVEL II**

AD

12

Report 2312

VERIFICATION TESTS OF THE US ELECTRICAR CORP.

"LECTRIC LEOPARD"

by

Edward J. Dowgiallo, Jr.  
Ivan R. Snellings

October 1980

Approved for public release; distribution unlimited.

DTIC  
ELECTE  
JAN 13 1981  
S D

U.S. ARMY MOBILITY EQUIPMENT C  
RESEARCH AND DEVELOPMENT COMMAND  
FORT BELVOIR, VIRGINIA

81 1 13 003

DOC FILE COPY



**Destroy this report when it is no longer needed.  
Do not return it to the originator.**

**The citation in this report of trade names of commercially  
available products does not constitute official endorsement  
or approval of the use of such products.**

UNCLASSIFIED

(14) MERADCOM-2312

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER 2312	2. GOVT ACCESSION NO. AD-A093746	3. RECIPIENT'S CATALOG NUMBER (9) Rept. for
4. TITLE (and Subtitle) VERIFICATION TESTS OF THE US ELECTRICAL CORP. ELECTRIC LEOPARD		5. TYPE OF REPORT & PERIOD COVERED Verification Test 15 Oct 79 - 30 Nov 79
6. AUTHOR(s) Edward J. Dowgiallo, Jr. Ivan R. Snellings		7. PERFORMING ORG. REPORT NUMBER
8. CONTRACT OR GRANT NUMBER(s) Interagency Agreement EC-77-A-31-1042		9. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
10. PERFORMING ORGANIZATION NAME AND ADDRESS Electrochem Div; Elec Pwr Lab; DRDME-EC US Army Mobility Equipment Research and Development Command; Fort Belvoir, VA 22060		11. REPORT DATE October 1980
12. CONTROLLING OFFICE NAME AND ADDRESS US Army Mobility Equipment Research and Development Command; ATTN DRDME-EC; Fort Belvoir, VA 22060		13. NUMBER OF PAGES 33
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) Prepared for Dept of Energy; Assistant Secretary for Conservation and Solar Energy; Division of Electric and Hybrid Vehicles		15. SECURITY CLASS. (of this report) Unclassified
16. DISTRIBUTION STATEMENT (of this Report)  Approved for public release; distribution unlimited.		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Electric Vehicle Propulsion Batteries Charger		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The US Electrical Corp. "Lectric Leopard" is a Renault Le Car that has been converted to an electric vehicle. It was tested by MERADCOM as part of a Department of Energy demonstration program. The performance test results are presented in this report. The vehicle is powered by 16 6-volt lead acid batteries through a contactor to the 48-volt 12-horsepower traction motor. It is equipped with front disc brakes, drum rear, and torsion bar suspension. It does not have regenerative braking.		

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

403160

Jm

## CONTENTS

Section	Title	Page
	ILLUSTRATIONS	iv
I	SUMMARY	1
II	INTRODUCTION	1
III	OBJECTIVES	1
IV	DESCRIPTION OF TEST VEHICLE	2
V	TEST RESULTS	2
VI	CHRONOLOGY OF VEHICLE FAILURES AND CORRECTIVE ACTIONS	7
	APPENDICES	
A.	VEHICLE DATA SUMMARY SHEET	8
B.	PERFORMANCE STANDARDS FOR DEMONSTRATIONS FEDERAL REGISTER, MAY 30, 1978 PART V, SUBPART B, PARA: 475.10	12
C.	ELECTRIC AND HYBRID VEHICLE VERIFICATION PROCEDURES	15

Accession For	
PTIS GRA&I	<input checked="" type="checkbox"/>
PTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A	

## ILLUSTRATIONS

Figure	Title	Page
1	Front Oblique View of the Lectric Leopard	3
2	Rear Oblique View of the Lectric Leopard	3
3	Rear Battery Module (Open)	4
4	Rear Battery Module (Covered)	4
5	Front Battery Module (Open)	5
6	Controller and Charger with Front Battery Module (Covered)	5
7	Instrument Panel	6

## **VERIFICATION TESTS OF THE US ELECTRICAR CORP.**

### **"LECTRIC LEOPARD"**

#### **I. SUMMARY**

The Lectric Leopard, manufactured by US Electricar Corporation of Athol, Massachusetts, was tested during the period 15 October to 30 November 1979. Complete test results are contained in Section V. Part of the verification results are summarized below:

Acceleration: 50 km/h in 12 s.

Range: SAE J227a cycle "C" on level ( $\pm 1$  percent grade), 58 km (36.1 mi) for 106 cycles.

Forward Speed Capability: Forward speed of 80 km/h (49.7 mi/h) was maintained for more than 5 min.

Gradeability at Speed: At 25 km/h (15 mi/h) the vehicle can traverse a 14-percent grade.

Gradeability Limit: 26.2 percent forward gradeability for at least 20 s, and a calculated reverse gradeability limit of 25 percent.

#### **II. INTRODUCTION**

The Lectric Leopard was operated to determine conformity to the Department of Energy (DOE), "Performance Standards for Demonstrations," published in the Federal Register, 30 May 1978, Part V. The results of that testing, as performed by the US Army Mobility Equipment Research and Development Command (MERADCOM), as well as other descriptive data concerning the vehicle, are presented in this report.

#### **III. OBJECTIVES**

The objectives of the test were to examine the Lectric Leopard for suitability of those aspects of vehicle and component operating characteristics as outlined by DOE's "Performance Standards for Demonstrations."



#### IV. TEST VEHICLE DESCRIPTION

The Electricar Letric Leopard is a standard Renault Le Car Passenger car which has been converted to an electric vehicle (Figures 1 and 2). The vehicle has a wheelbase of 2.44 m (8 ft) and is 3.66 m (12 ft) long and 1.52 m (5 ft) wide. The Leopard has a curb weight of 1170 kg (2580 lb) and can seat 4 people, including the driver; the Leopard has a gross vehicle weight of 1362 kg (3000 lb). It is powered by sixteen 6-volt lead-acid batteries manufactured by Deka Corporation. The batteries have a capacity of 138 Ah. The batteries are configured as two modules, one under the hood of the vehicle and the other in the rear behind the seat (Figures 3, 4, and 5). The contactor controller manufactured by US Electricar is located under the hood to the right of the battery compartment (Figure 6).

The propulsion motor is a 12-hp, compound-wound d.c. motor manufactured by Prestolite Corporation. The Leopard has the standard Renault Le Car torsion bar suspension, hydraulic shocks, 4-speed synchromesh transmission, and disc brakes in the front with drum in the rear. The tires are Michelin SR-13 steel belted radials inflated to 30 lb/in<sup>2</sup>. The Leopard comes equipped with its own on-board charger manufactured by US Electricar Corporation, rated at 120 VAC and having a peak current of 20 A.

The Letric Leopard comes equipped with standard equipment such as windshield wipers, heater-defroster, fuel gauge, ammeter, speedometer, and odometer (see Figure 7 and Appendix A). The heater is a resistance-type with a capacity of 4,000 Btu/h.

#### V. TEST RESULTS

The following are the results of the verification tests performed at MERADCOM during 15 October to 30 November 1979. Paragraphs are referenced to the DOE "Performance Standards for Demonstrations" criteria.

- (a) Acceleration: 50 km/h in 12 s.
- (b) Gradeability at Speed: At 25 km/h (15 mi/h) the vehicle can traverse a 14-percent grade based on calculations from acceleration tests.
- (c) Gradeability Limit: Calculations based on drawbar pull tests indicate 26.2-percent forward gradeability for at least 20 s. Reverse gradeability was calculated based on the reverse gear ratio of 3.7:1 relative to the forward first gear ratio of 3.545:1 which results in a 25-percent gradeability limit.
- (d) Forward Speed Capability: Forward speed of 80 km/h (49.7 mi/h) was maintained for a minimum of 5 min on the level portion ( $\pm$  1-percent grade) of the MERADCOM test track.



Figure 1. Front oblique view of the Letric Leopard.

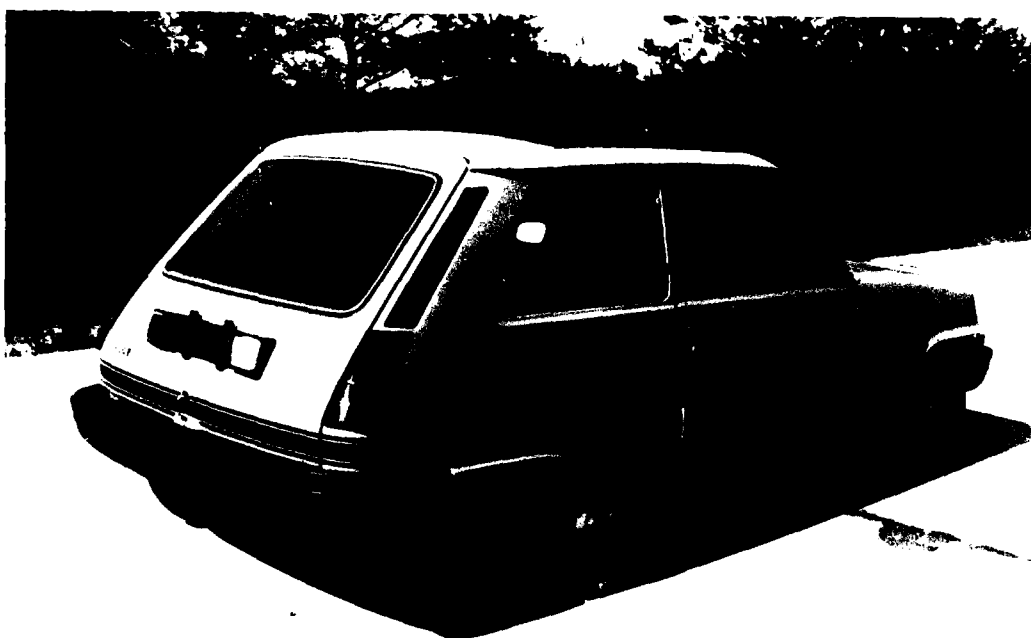


Figure 2. Rear oblique view of the Letric Leopard.

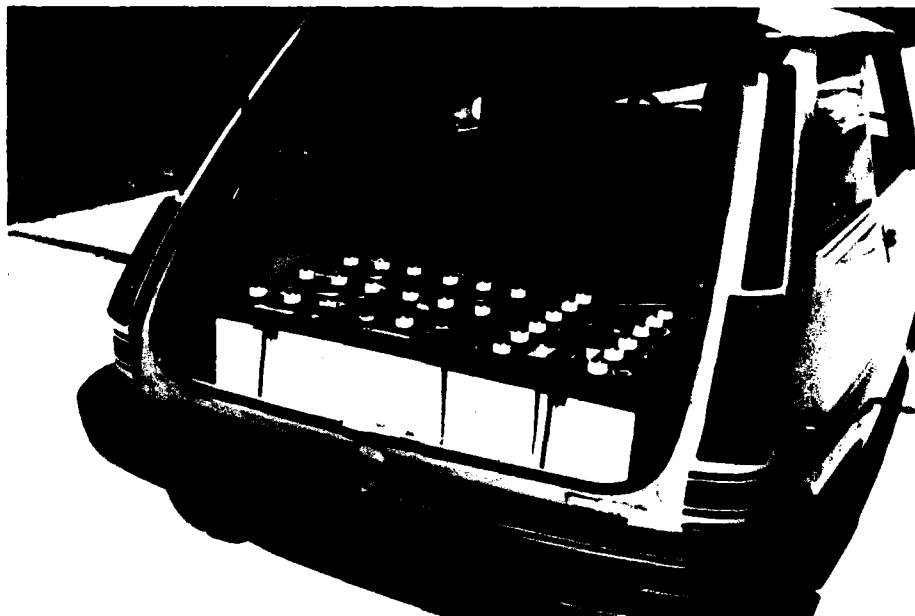


Figure 3. Rear battery module (open).



Figure 4. Rear battery module (covered).

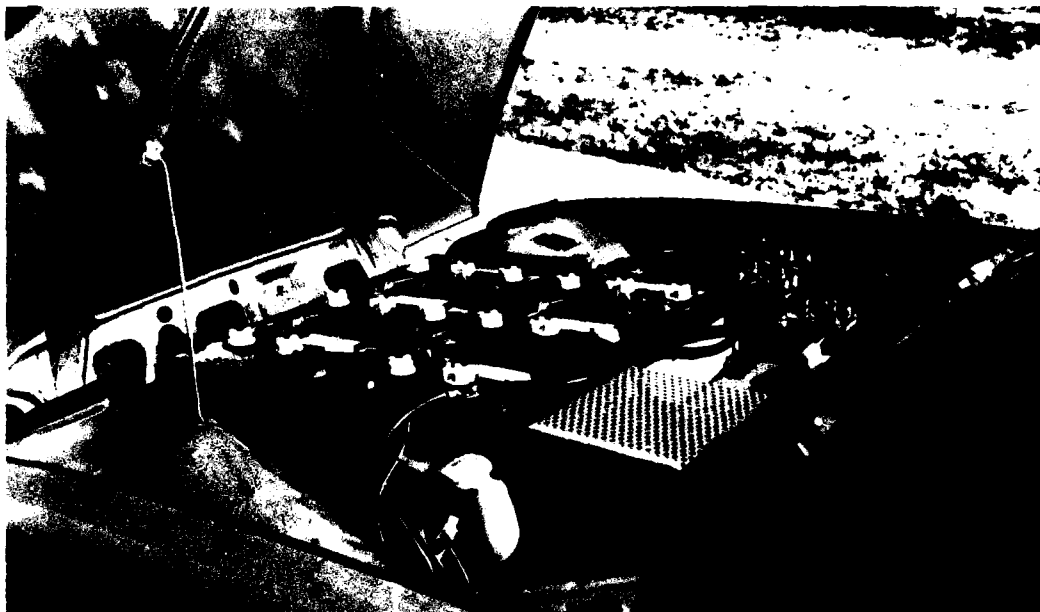


Figure 5. Front battery module (open).

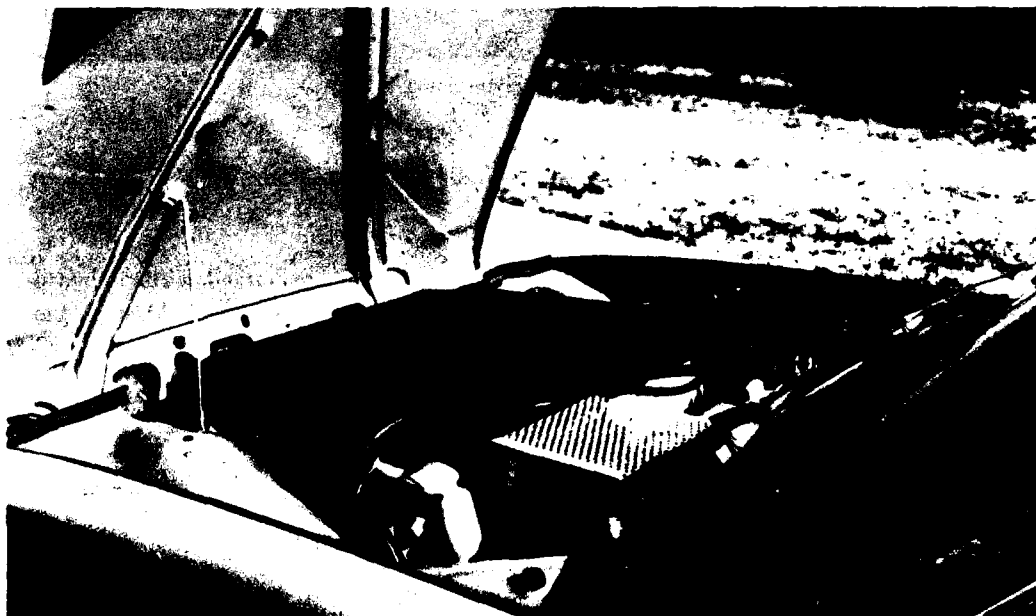


Figure 6. Controller and charger with front battery module (covered).

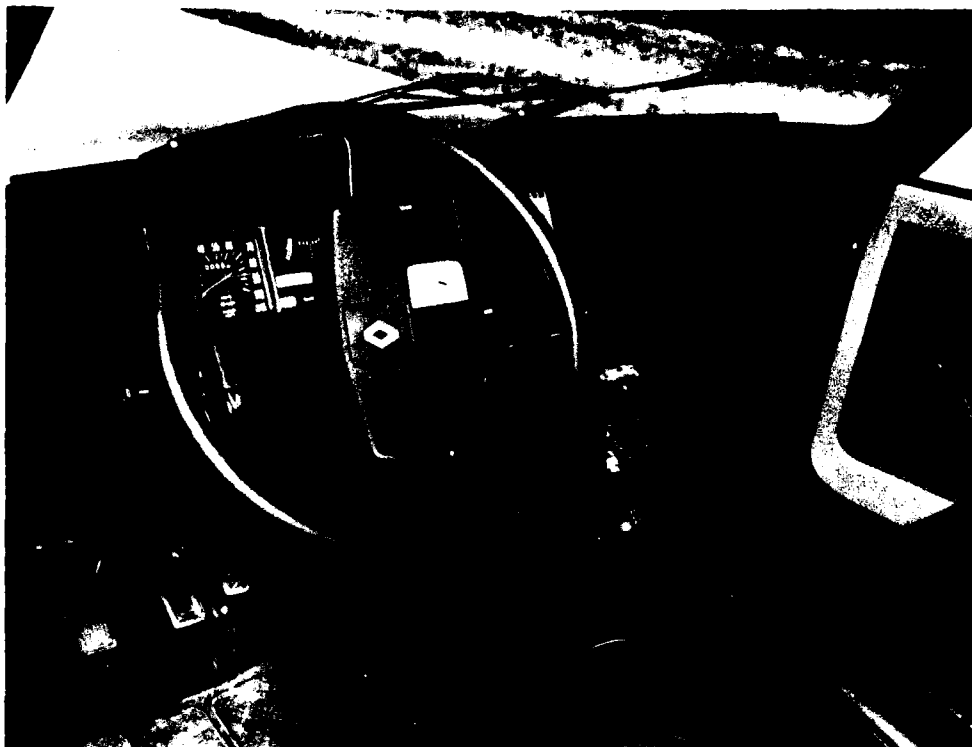


Figure 7. Instrument panel.

(e) Range: SAE J227a cycle "C" on level ( $\pm$  1-percent grade 58 km (36.1 mi)) for 106 cycles.

(f) Battery Recharge Time: After an 80-percent discharge, recharged with on-board charger (20 A, 120 VAC) for 10 h; after recharge, vehicle operated for at least 50 km (31.1 mi) to SAE J227a cycle "C" regime.

(g) Recharge Control: Timer, maximum setting of 16 h.

(h) Energy Consumption: All components of the vehicle used electrical energy.

(i) Battery:

(1) Warranty: 30 days unconditional, then on prorated basis up to 12 m.

(2) Type: Deka.

(3) Capacity: 138-Ah (75 A for 110 min).

(4) Voltage: The sixteen 6-volt battery modules are connected in series/parallel configurations to produce either a manually switched 48 volts for charge or a two-step accelerator switched 24 or 48 volts for discharge through the motor.

(j) State-of-Charge Meter: Voltmeter, three-color band, manufactured by US Electricar, showing percent of charge.

(k) Odometer: Yes.

(l) Passenger Comfort Heater: Yes; electrical-resistance type.

(m) Documentation: Maintenance manual, operator's manual, and owner's manual were submitted. No parts lists were submitted.

(n) Safety: The Department of Transportation (DOT) is performing these evaluations; however, MERADCOM performed the following limited checks for design intent:

(1) Electrical Isolation: The electrical propulsion system is isolated by design.

(2) Safety Standards 208 and 301: DOT will check compliance.

(3) Battery Caps: Standard golf-cart industry type. Flame-barrier characteristics were not tested.

(4) Ventilation of Battery Compartment: The battery compartments have no forced-air ventilation and are not completely sealed from the driver or passengers.

(5) Battery Emergency Disconnection: None. However, the vehicle has a clutch for disconnection of the drive train from the electric propulsion system.

(6) Parked Temperature Effect: Parked vehicle for an 8-h period at each of the temperatures: -25°C and 50°C. Subsequent operation revealed no apparent damage to vehicle or hazard to persons.

## VI. CHRONOLOGY OF VEHICLE FAILURES AND CORRECTIVE ACTIONS

No significant failures occurred.

## **APPENDIX A**

### **VEHICLE SUMMARY DATA SHEET**

#### **1. Vehicle Manufacturer:**

US Electricar Corp.  
2342 Main St.  
Athol, Massachusetts 01331

#### **2. Vehicle Description:**

Name: Lectric Leopard  
Model: 953  
Availability: 30 days  
Price: \$7995.00

#### **3. Vehicle Weight:**

Curb Wt: 1171 kg (2580 lb)  
Payload Wt: 190.68 kg (420 lb) includes 4 passengers  
Gross Wt: 1362 kg (3000 lb)

#### **4. Vehicle Size:**

Wheelbase: 2.43 m (8 ft)  
Length: 3.65 m (12 ft)  
Width: 1.52 m (5 ft)  
Headroom: 0.91 m (3 ft)  
Legroom: 0.61 m (2 ft)

#### **5. Auxiliaries & Options:**

No. Lights: 11  
a. Headlights, Parking, Signal, Dome, Taillight  
b. License Tag, Backup, Stop, Emergency, Dashboard  
c. Running Lights

Windshield Wipers: Yes  
Windshield Washers: No  
Defroster: Yes  
Heater: Yes  
Radio: No  
Fuel Gauge: Yes  
Ammeter: Yes  
Tachometer: No  
Speedometer: Yes  
Odometer: Yes  
No. Mirrors: 2  
Power Steering: No  
Power Brakes: No  
Transmission Type: 4-speed manual (synchromesh)

**6. Propulsion Batteries:**

Type: lead-acid  
Manufacturer: Deka  
No. of Modules: 16  
No. Cells: 48  
Battery Voltage: 48 volts  
AH Capacity: 138  
Battery Size: 181 mm x 257 mm x 279 mm (7-1/8 in. x 10-1/8 in. x 11 in.)  
Battery Wt: 27.2 kg (60 lb)  
Battery Age: New  
Battery Rate: 75 A for 110 min  
Battery Cycles: 400

**7. Auxiliary Battery:**

Type: lead-acid  
Manufacturer: Deka  
No. Cells: 6  
Battery Voltage: 12  
AH Capacity: 35  
Battery Size: 241 mm x 181 mm x 165 mm (9½ in. x 7 in. x 6½ in.)  
Battery Rate: 20 h  
Battery Wt: 16.8 kg (37 lb)



**8. Controller:**

Type: contactor  
Manufacturer: US Electricar  
Voltage Rating: 48 V  
Current Rating: 500 A  
Size: 181 mm x 228 mm x 127 mm (7 in. x 9 in. x 5 in.)  
Wt: 11.3 kg (25 lb)

**9. Propulsion Motor:**

Type: compound  
Manufacturer: Prestolite  
Insulation Class: H  
Voltage Rating: 48 V  
Current Rating: 300 A  
HP Rating: 12 hp  
Size: 180.97 dia. (7-1/8 in.) 431.8 mm long (17 in.)  
Wt: 45.3 kg (100 lb)  
Rated Speed: 3000 r/min

**10. Body:**

Type: sedan  
Manufacturer: Renault  
No. Doors: 3  
Type: side, hatch  
No. Windows: 6  
Type: glass  
No. Seats: 4  
Type: bucket (front) bench (retractable rear)  
Cargo Volume: 0.72 m<sup>3</sup> (25.5 ft<sup>3</sup>)

**11. Chassis:**

Type Frame: std (Le Car)  
Manufacturer: Renault  
Type Material: steel  
Modifications: none  
Type Springs: torsion bar  
Type Shocks: hydraulic  
Axle Type Front: transaxle

Axle Type Rear: std Renault  
Axle Manufacturer: Renault  
Drive Line Ratio: 20:1  
Type Brakes Front: disc  
Type Brakes Rear: drum  
Regenerative Brakes: No  
Tire Type: radial  
Manufacturer: Michelin  
Size: SR-13  
Pressure: 206.84 kPa (30 lb/in.<sup>2</sup>)

**12. Battery Charger:**

Type: transformer  
Manufacturer: US Electricar  
On or Off Board: on  
Input Voltage: 120 V  
Peak Current: 20 A  
Recharger Timer: 16 h  
Wt: 27.2 kg (60 lb)  
Automatic Turn Off: Yes

## **APPENDIX B**

### **PERFORMANCE STANDARDS FOR DEMONSTRATIONS**

#### **FEDERAL REGISTER**

**TUESDAY MAY 30, 1978**

#### **PART V, SUBPART B, PARA: 475.10**

##### **475.10 MINIMUM LEVELS OF PERFORMANCE FOR PERSONAL-USE VEHICLES.**

The following minimum levels of performance are required with respect to any personal-use vehicles purchased or leased pursuant to section 7 (c) of the Act.

(a) Acceleration. The time required to accelerate from rest to 50 km/h shall not exceed 15 s.

(b) Gradeability at speed. The grade which can be traversed up at 25 km/h shall be at least 10 percent.

(c) Gradeability limit. The grade on which the vehicle can start and climb for 20 s either backward or forward shall be no less than 20 percent.

(d) Forward speed capability. The speed which can be maintained for 5 minutes will be 80 km/h.

(e) Range. The distance which the vehicle can be operated with vital accessories on or equivalent shall be:

(1) For an electric vehicle, at least 50 km on the SAE J227a/C cycle.

(2) For a hybrid vehicle, at least 200 km on the SAE J227a/C cycle.

(f) Battery recharge time. The vehicle shall be capable of satisfying the range requirement of 475.10 (e) above, after being recharged for no more than 10 hours by use of an onboard charger. At the start of this recharge the vehicle shall have 80 percent

discharged batteries as specified by the vehicle test conditions and procedures of 475.3. The onboard charger shall be compatible with an electric power outlet of 110 V or 220 V a.c., as specified by the vehicle manufacturer.

(g) Recharge control. The vehicle shall have a recharge control which is adequate to meet the requirements of energy, life, and safety as such requirements are stated by these performance standards.

(h) Energy consumption.

(1) For an electric vehicle, the maximum amount of nonelectrical energy consumed shall be that used for operation of the accessories only.

(2) For a hybrid vehicle, nonelectrical energy consumed shall not exceed 1.3 MJ/km and shall also not exceed 75 percent of total energy consumed for propulsion and vital accessories, based on being fully loaded on a driving schedule of 33 km on SAE J227a/C cycle plus 33 km at 75 km/h (higher heating value of gasoline taken as 32.7 MJ/L) with vital accessories on.

(i) Battery life.

(1) The vehicle shall be capable of at least 75 percent of the range specified in 475.10 (e) after 12 months or 15,000 km of normal use, whichever occurs first.

(2) The vehicle shall be capable of 100 percent of the acceleration and gradeability specified in 475.10 (a), (b), and (c), for all test conditions and procedures specified by 475.3, for 12 months or 15,000 km of normal use, whichever occurs first.

(3) The batteries shall, if necessary, be repaired or replaced by the vehicle manufacturer at no cost to the user of the vehicle in order to meet requirements of (1) and (2) of 475.10 (i).

(j) State-of-charge meter. The vehicle shall have a state-of-charge meter for the propulsion battery system or other means of providing an indication of remaining range.

(k) Odometer. The vehicle shall have an odometer.

(l) Passenger comfort heater. The vehicle shall have a passenger comfort heater available as an option.

(m) Documentation. Adequate user manuals, maintenance (service) manuals, and parts lists shall be provided.

(n) Emissions. The vehicle shall comply with all applicable Federal emissions regulations for motor vehicles.

(o) Safety, crashworthiness, damageability, crash avoidance, and hazards.

(1) The vehicle shall comply with all applicable Federal regulations for motor vehicles concerning safety, crashworthiness, damageability, crash avoidance, and hazards, unless a waiver or modification is obtained from the Department of Transportation.

(2) Until the Department of Transportation issues regulations which cover the same subjects, the vehicle shall also have the following performance characteristics:

(i) The electric propulsion circuit shall be electrically isolated from other conductive portions of the vehicle.

(ii) The vehicle shall be capable of undergoing the test procedure of Federal Motor Safety Standards 208 and 301 with all battery materials remaining outside the passenger compartment.

(iii) Vehicles with battery caps or battery vents shall have flame barrier provisions to inhibit battery explosions.

(iv) Ventilation shall be adequate within the battery compartment to maintain the concentration of hydrogen below 4 percent by volume during vehicle operation (including charging and maintenance).

(v) The vehicle shall have a device which provides for the positive disconnection of the battery and which is operable from the normal operator position.

(vi) The vehicle shall be capable of being parked for up to 8 hours in temperatures of -25°C to 50°C and subsequently operated at any temperature within this temperature range without damage to the vehicle or hazard to persons.

## **APPENDIX C**

### **ELECTRIC AND HYBRID VEHICLE VERIFICATION PROCEDURES**

#### **Background**

DOE is required by Public Law 94-413 to issue performance standards for vehicles used in the Electric and Hybrid Vehicle (EHV) Market Demonstration. On May 30, 1978, DOE published a final rule in the Federal Register (Vol. 43, No. 104) promulgating the first Performance Standards. This rule was effective on 3 July 1978 and prescribed minimum performance standards for electric and hybrid vehicles to be purchased or leased for the first phase of a demonstration program under the Electric and Hybrid Research, and Development Act of 1976. Performance Standards are updated from time to time and the current rule was published in the Federal Register on February 12, 1980 (Vol. 45, No. 30).

Manufacturers who certify that their vehicles meet the latest requirements of the DOE Performance Standards may offer those vehicles for the DOE Market Demonstration Program. DOE reserves the right to verify, by independent test, the manufacturer's self-certification. The test procedures used for DOE performance tests are based on SAE Test Procedures J227a. Safety inspection and testing services are provided by the Department of Transportation/National Highway and Traffic Safety Administration (DOT/NHTSA) through an interagency agreement. Performance testing is performed by the US Army Mobility Equipment Research and Development Command (MERADCOM) through an interagency agreement. During verification testing vehicle component or subsystem failures will be immediately brought to the attention of the manufacturer. Repeated or multiple component or subsystem failures experienced during test are grounds for invalidating the self-certification of the vehicle for purpose of the DOE Market Demonstration Program.

#### **Certification Process**

A manufacturer can certify an existing vehicle as meeting the DOE Standards (which include applicable NHTSA safety standards by reference) at any time by submitting a letter of certification and providing the required data on the vehicle to the Department of Energy Director of Electric and Hybrid Vehicles Division or his designee.

## **Verification Process**

Should DOE elect to verify the certification, arrangements will be made with the manufacturer for delivery of the vehicle to a DOE-specified site for testing. (Details of scheduling priorities are described in the following section.) Several basic types of tests may be involved:

- DOE-Sponsored Performance Tests by the US Army MERADCOM.
- DOE-Sponsored Safety Inspection by DOT/NHTSA.
- DOE-Sponsored Safety Compliance Testing by the Research Division of DOT/NHTSA.
- DOT/NHTSA Safety Compliance Test (Independent of DOE).

One important principle followed by DOE during testing is to allow the Facility Manager to work with manufacturers to overcome the normal problems that occur during inspection and testing. To ensure impartial treatment of manufacturers during the test sequence, limits have been set for the Test Facility Manager concerning how many vehicle component or subsystem failures can be allowed before certification is invalidated. DOE will objectively evaluate the impact of all failures during the testing phase so that vehicles are not unfairly penalized for minor and easily correctable failures. The Test Facility Manager, however, has an obligation to conduct the testing thoroughly and to adhere to a tight schedule.

Manufacturers may be notified from time to time by the Test Facility Manager of potential and actual problems. When these problems do not involve components of subsystem failures, where failure is defined as a vehicle being below the required standard, such notification would not necessarily invalidate the certification.

## **Test Facility Scheduling Guidelines**

Vehicles will be scheduled for testing by the Test Facility Manager on a first-come, first-served basis, with certain exceptions as noted below. Scheduling is dependent upon the ability of the manufacturer to provide a vehicle for testing. The Test Facility Manager will request the manufacturer to provide a certified vehicle for testing within 60 days from the date of the request. If a vehicle is not received at the Test Facility within the 60-day period, the self-certification will be returned and the vehicle will be removed from the self-certification list.

The primary function of certification testing is to ensure that vehicles available to the Market Demonstration Program fully satisfy the applicable DOE Performance Standards. For this reason, it is necessary to establish a set of priority testing categories for vehicles selected or being considered for selection by demonstration site operators. The categories are listed below in decreasing order of priority for testing:

1. Certified vehicles which have not been verified but have been purchased by and delivered to site operators.
2. Certified vehicles purchased by but not delivered to site operators for demonstration.
3. Certified vehicles that have been modified subsequent to verification testing and have been delivered to site operators.\* On request by DOE, the manufacturer will furnish DOE with technical information about each modification in sufficient detail to determine if reverification tests are needed.
4. Certified vehicles that are being considered for purchase by a site operator.
5. Certified vehicles that are available for test but are not under consideration by a site operator.

Vehicle test schedules are sensitive to the requirements of the Market Demonstration Program, and rescheduling by the Test Facility Manager may be required to meet changing needs. Vehicles delivered late or taken out of test because of operational failures may be rescheduled on a lower priority basis by the Test Facility Manager with approval of the DOE Test Manager. On-site rectification of a vehicle problem by the manufacturer within a 5-working-day period described below may avoid the necessity for rescheduling.

#### **Vehicle Modification/Repair Guidelines**

The guidelines provided in this section are for use by the Test Facility Manager. Exceptions to these guidelines require the approval of the Director of the DOE Electric and Hybrid Vehicle Division or his designee. The intent of these guidelines is to facilitate the establishment of a clear basis for validating or invalidating a manufacturer self-certification. Subsystem failures may raise questions as to the relevance of the results of the validation testing. It is also important that the test facilities not be used for development and test engineering. Vehicles that experience repeated failures of the same component of subsystems must be upgraded before verification testing can be rescheduled. Rescheduling will be contingent on the submission and acceptance of evidence, obtained

\* The manufacturer is responsible for notifying the DOE Director of the Electric and Hybrid Vehicle Division or his designee of all modifications to the verified production configuration.



by the manufacturer through testing, that the cause of failure has been corrected. The Test Facility Manager will determine when significant repairs should be and have been made.

#### **Vehicle Modifications/Repairs On or Near the Test Facility**

A. Only those modifications or repairs that can be completed within 5 working days by the manufacturer or his designee will be allowed. If the repairs cannot be completed within this period, the vehicle must be removed from the test facility unless DOE programmatic requirements dictate that it is in the best interest of the Government that a waiver be granted by the Director of the Electric and Hybrid Vehicles Division or his designee.

B. All failures requiring repair, whether significant or insignificant, will be recorded by the Test Facility Manager or his designee. For all repairs the manufacturer must submit (to the Test Facility Manager) written explanation of the failure modes and the corrective action taken within 15 days after completion of corrective action. Failed components or subsystems must be replaced by an identical part except in those cases where the component or subsystem design is inadequate. In the latter case, the manufacturer may substitute a readily available component or system when the manufacturer can provide assurance of improved reliability and performance.

C. Three on-site repairs to correct a significant powertrain failure are allowed. A fourth failure will invalidate the vehicle certification, and the Facility Manager will order the vehicle to be returned to the manufacturer unless DOE programmatic requirements dictate that a waiver be granted by the Director of the Electric and Hybrid Vehicles Division or his designee.

D. Subject to overriding priority considerations, testing will be resumed as soon as repairs are completed.

#### **Vehicles Returned to the Manufacturer Because of Failure in Test**

A. A letter invalidating the certification will be issued to the manufacturer and DOE will notify site operators of the invalidation. A report including the vehicle failures will be provided by DOE to members of the public requesting such a report. Vehicles that are part of the Market Demonstration Program (based on the manufacturer's self-certification) which fail the verification tests will have their certification invalidated until successful correction of the defects is completed. Future funding to site operators for the invalidated vehicle model will be suspended until corrections are completed.

B. A one-time voluntary withdrawal of a vehicle from test by a manufacturer to correct problems is allowed for a period not to exceed 60 days. The vehicle will be rescheduled for testing based on priorities at the time of resubmittal. No action will be taken to invalidate the certification during the voluntary withdrawal period unless there is a clear case of user safety involved or the manufacturer fails to offer the vehicle for test after 60 days.

C. Before a vehicle can be resubmitted for testing, the manufacturer must provide to the Director of the Electric and Hybrid Vehicles Division, or his designee, appropriate evidence that modifications and/or repairs have been made. The manufacturer must also provide substantiating test data to show that the vehicle can meet all DOE Performance Standards.

D. Repaired vehicles returned by the manufacturer may be required to undergo the complete series of verification tests regardless of the portion of testing completed prior to invalidation of certification. The Test Facility Manager with the approval of DOE, will determine the necessity for such retesting.

#### **Grounds for Invalidating Certification**

1. A vehicle will be returned to the manufacturer after four significant powertrain failures or a single powertrain failure that cannot be corrected, and its certification will be invalidated.

2. A vehicle that fails to meet applicable DOE Performance Standards will have its certification invalidated. (The standards include documentation and warranty provisions.)

3. A vehicle that fails to comply with applicable DOT/NHTSA Safety Regulations will have its certification invalidated.

4. If a manufacturer fails to commit to and follow a reasonable schedule (defined in the following section) to provide a vehicle for testing when requested by DOE, the vehicle will have its certification invalidated.

#### **Summary of Responsibility of Manufacturers**

Manufacturers must self-certify their production vehicles to participate in the DOE Market Demonstration Program. They must also commit to a reasonable schedule to provide a vehicle for verification testing upon request from the DOE designated Test Facility Manager. If this delivery cannot be made within 60 days after receipt of such a request, the self-certification letter will be returned and the vehicle will be removed from the self-certified list.

Manufacturers must provide required and necessary information to document the vehicle configuration:

- Vehicle Summary Data Sheets,
- Operator's Manual, and
- Service and Maintenance Manual including a parts list.

This information may be in draft form, but it must be complete enough to be useful should any mechanical or electrical difficulty develop in the vehicle.

The manufacturer will notify the Director of the Electric and Hybrid Vehicles Division or his designee of all modifications to previously verified production configurations within 30 days of the sale of such modified vehicles to DOE site operators. If it is requested, the manufacturer shall furnish the DOE Test Manager with technical information about each modification in sufficient detail to determine if reverification tests are needed.

For vehicles receiving an invalidation of certification, the manufacturer must provide to the Director of the Electric and Hybrid Vehicles Division appropriate evidence that modifications and/or repairs have been made and must also provide substantiating test data to show that the vehicle can meet all DOE Performance Standards prior to resubmittal of the vehicle for test. Following successful verification testing, vehicles already in DOE site operator fleets must be modified and/or repaired in the same manner as the vehicle successfully tested. A modification and/or repair schedule acceptable to the Director of the Electric and Hybrid Vehicles Division must be developed and followed by the manufacturer as a condition for validation of the manufacturers certification.

#### **DOE Notification Documentation**

DOE will notify manufacturers of actions taken during the verification testing process, including but not limited to:

- Receipt of self-certification.
- Notification of vehicle failure.
- Validation or invalidation of certification.
- Final Test Report.

# DISTRIBUTION FOR MERADCOM REPORT 2312

No. Copies	Addressee	No. Copies	Addressee
	<b>Department of Defense</b>	1	Director US Army Materiel Systems Analysis Agency ATTN: DRXSY-MP Aberdeen Proving Ground, MD 21005
1	Director, Technical Information Defense Advanced Research Projects Agency 1400 Wilson Blvd Arlington, VA 22209	1	Commander US Army Troop Support and Aviation Materiel Readiness Command ATTN: DRSTS-MES (1) 4300 Goodfellow Blvd St Louis, MO 63120
1	Director Defense Nuclear Agency ATTN: TITL Washington, DC 20305	1	Director Petrol & Fld Svc Dept US Army Quartermaster School Fort Lee, VA 23801
1	Defense Technical Information Ctr Cameron Station Alexandria, VA 22314	1	Commander US Army Electronics Research and Development Command Technical Library Division ATTN: DELSD-L Fort Monmouth, NJ 07703
	<b>Department of the Army</b>		
1	Commander, HQ TRADOC ATTN: ATEN-ME Fort Monroe, VA 23651	1	HQ, 193D Infantry Brigade (Pan) ATTN: AFZU-FE APO Miami 34004
1	Technical Library Chemical Systems Laboratory Aberdeen Proving Ground, MD 21010	1	Special Forces Detachment, Europe ATTN: PBO APO New York 09050
1	Commander US Army Aberdeen Proving Ground ATTN: STEAP-MT-U (GE Branch) Aberdeen Proving Ground, MD 21005	1	Commander Rock Island Arsenal ATTN: SARRI-LPL Rock Island, IL 61201
1	Director US Army Materiel Systems Analysis Agency ATTN: DRXSY-CM Aberdeen Proving Ground, MD 21005		

No. Copies	Addressee	No. Copies	Addressee
1	HQDA ODCSLOG DALO-TSE Room 1E588 Pentagon, Washington, DC 20310		Spec Asst/Matl Asmt, DRDME-ZG Spec Asst/Secs & Tech, DRDME- DRDME-ZK CIRCULATE
1	Commander Headquarters, 39th Engineer Battalion (Cbt) Fort Devens, MA 01433	1	Chief, Ctrmine Lab, DRDME-N Chief, Engy & Wtr Res Lab, DRDME-G Chief, Elec Pwr Lab, DRDME-E Chief, Camo & Topo Lab, DRDME-R Chief, Mar & Br Lab, DRDME-M Chief, Mech & Constr Eqpt Lab, DRDME-H Chief, Ctr Intrus Lab, DRDME- DRDME-X Chief, Matl Tech Lab, DRDME- DRDME-V Director, Product A&T Directorate, DRDME-T CIRCULATE
1	Commander and Director USA FESA ATTN: FESA-TS Fort Belvoir, VA 22060		
1	Director US Army TRADOC Systems Analysis Activity ATTN: ATAA-SL (Tech Lib) White Sands Missile Range, NM 88002		
1	HQ, USAEUR & Seventh Army Deputy Chief of Staff, Engineer ATTN: AEAEN-MT-P APO New York 09403	200	Electrochemical Div, DRDME-EC
1	HQ, USAEUR & Seventh Army Deputy Chief of Staff, Operations ATTN: AEAGC-FMD APO New York, 09403	3	Tech Reports Ofc, DRDME-WP
2	District Engineer ATTN: SWFED-MF FWD Corps of Engineers P.O. 17300 Fort Worth, TX 76102	3	Security Ofc (for liaison officers), DRDME-S
		2	Tech Library, DRDME-WC
		1	Programs & Anal Dir, DRDME-U
		1	Pub Affairs Ofc, DRDME-I
		1	Ofc of Chief Counsel, DRDME-L
	<b>MERADCOM</b>		<b>Department of the Navy</b>
1	Commander, DRDME-Z Technical Director, DRDME-ZT Assoc Tech Dir/R&D, DRDME-ZN Assoc Tech Dir/Engrg & Acq, DRDME-ZE	2	Commander, Naval Facilities Engineering Command Department of the Navy ATTN: Code 032-B 062 200 Stovall St Alexandria, VA 22332

No. Copies	Addressee	No. Copies	Addressee
1	US Naval Oceanographic Office Navy Library/NSTL Station Bay St Louis, MD 39522		<b>Others</b>
1	Library (Code L08A) Civil Engineering Laboratory Naval Construction Battalion Center Port Hueneme, CA 93043	1	Professor Raymond R. Fox School of Engineering and Applied Science George Washington University Washington, DC 20052
1	Naval Training Equipment Center ATTN: Technical Library Orlando, FL 32813	3	Batronic Truck Corp Third & Walnut St Boyertown, PA 14512
3	Naval Weapons Center (Code 2605) China Lake, CA 93555		<b>Department of Energy</b>
	<b>Department of the Air Force</b>	200	ATTN: Walter J. Dippold 100 Independence Ave Mail Stop 5H044 Room 5H063 Forrestal Bldg Washington, DC 20585
1	HQ USAF/RDPT ATTN: Mr. Allan Eaffy Washington, DC 20330	1	Albert Cook International Lead Zinc Research Organization, Inc 292 Madison Ave New York, NY 10017
1	Mr. William J. Engle Chief, Utilities Branch HQ USAF/PREEU Washington, DC 20332	1	Bernie Wahcter DAO Corp 2101 Street NW Washington, DC 20037
1	US Air Force HQ Air Force Engineering & Services Ctr Technical Library FL 7050 Tyndall AFB, FL 32403	1	C. Joseph Venuto 3043 Walton Road Plymouth Meeting, PA 19462
1	Department of Transportation Library, FOB 10A, M494-6 800 Independence Ave., SW Washington, DC 20591	1	J. Hampton Barnett Energy Demonstration & Technology 109 United Bank Building Chattanooga, TN 37401
1	Mr. Carl Anderson Energy Technology Demonstration SM-ALC/XAE McClellan AFB, CA 95652		

No. Copies	Addressee	No. Copies	Addressee
1	Department of Transportation Library, FOB 10A, TAD-494.6 800 Independence Ave, SW Washington, DC 20591	1	Cornell University Joe Rosson, Associate Director School of Engineering Phillips Hall Ithaca, NY 14853
1	A. D. Little ATTN: Brad Underhill 15 Acorn Park Cambridge, MA 02140	1	Department of Industry, Trade, and Commerce Fred Johnson, Special Vehicle Div Transportation Industries Branch Ottawa, Canada, KIA085
1	Advance Ground Systems Eng ATTN: Dr. George Gelb 3270 E. 70th Street Long Beach, CA 90805	1	Department of Transportation Transportation Systems Center ATTN: Dr. Norman Rosenberg Cambridge, MA 02142
1	Airesearch Manufacturing Co. ATTN: Bob Rowlett Program Manager 2525 W. 190th Street Torrance, CA 90509		Electric Power Research Institute ATTN: Dr. Fritz R. Kalhammer
1	Argonne National Labs ATTN: Al Chilenskas 9700 South Cass Avenue Argonne, IL 60439	1	ATTN: Ralph Ferraro 3412 Hillview Avenue P.O. Box 10412 Palo Alto, CA 94034
1	Billings Energy Corporation ATTN: Mr. Hadden P.O. Box 555 Provo, UT 84601	1	Energy Research and Development Corp ATTN: R. Childs, President 9135 Fernwood Drive Olmsted Falls, OH 44138
1	Booz, Allen & Hamilton Inc John F. Wing Transportation Consulting Div 4330 East West Highway Bethesda, MD 20014	1	ESB, Inc. 5 Penn Center Plaza Philadelphia, PA 19103
1	Borisoff Engineering Co 7726 Burnet Ave Van Nuys, CA 91405	1	General Electric Corporate Research & Development ATTN: Gene Rowland Program Manager P.O. Box 8 Schenectady, NY 12301
1	Cooper Development Association ATTN: Donald K. Miner, Manager 430 N. Woodward Ave Birmingham, MI 48011		

No. Copies	Addressee	No. Copies	Addressee
1	General Research Corporation ATTN: John Brennand 5383 Hollister Avenue Santa Barbara, CA 93105	1	Society of Automotive Engineers, Inc William Toth, Staff Engineer 400 Commonwealth Warrendale, PA 15096
1	General Services Administration Federal Supply Service ATTN: Mel Globeman Washington, DC 20406	1	United States Postal Service ATTN: Dick Bowman Office of Fleet Mgmt Delivery Services Dept Washington, DC 20260
1	General Services Administration Federal Supply Service ATTN: R. L. Ullrich Washington, DC 20406	1	United States Postal Service ATTN: Donn Crane, Director Office of Fleet Mgmt Delivery Services, Dept Washington, DC 20260
2	Jet Propulsion Laboratory ATTN: T. Barber 4800 Oak Grove Drive Pasadena, CA 91103	1	United States Postal Service Research & Development Lab ATTN: Lewis J. Gerlach Program Manager 11711 Park Lawn Drive Rockville, MD 20852
1	Los Alamos Scientific Labs Byron McCormick P.O. Box 1663 Los Alamos, New Mexico 87545	1	United States Postal Service ATTN: Thomas W. Martin, Manager Vehicle Services Branch Western Region San Bruno, CA 94099
1	NASA-Lewis Research Center ATTN: J. S. Fordyce MS: 309-1 21000 Brookpark Road Cleveland, OH 44135	1	University of California Jack Bolger Lawrence Berkeley Labs Berkeley, CA 94720
2	NASA-Lewis Research Center ATTN: H. J. Schwartz MS: 500-215 21000 Brookpark Road Cleveland, OH 44135	1	Westinghouse R&D Center ATTN: G. Frank Pittman, Jr. 1310 Beulah Road Pittsburgh, PA 15235
1	Peto-Electric Motors, Ltd ATTN: Victor Wouk, Consultant 342 Madison Avenue, Suite 831 New York, NY 10017	1	Clinton Christianson Argonne National Laboratory 9700 South Lass Avenue Argonne, IL 60439
1	Purdue University IIES A.A. Potter Engineering Center ATTN: Dr. R. E. Goodson W. Lafayette, IN 47907		



No. Copies	Addressee
1	Marhorie L. McClanahan Chemical Process Unit Materials Technology Aeronutronic Division Ford Aerospace & Communications Corporation Ford Road Newport Beach, CA 92663
1	F. J. Liles 705 Buffalo Drive Arlington, TX 76013
1	C. Grandy Union Electric Co. P.O. Box 149 St Louis, MO 63166
3	U.S. Electricar Corp. ATTN: Chan Waterman 2324 Main Street Athol, MA 01331